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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/799,160	03/12/2004	Yung-Hoon Ha	17648-0026	9525

29052 7590 05/11/2007
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EXAMINER

SANDERS, JANIS C

ART UNIT	PAPER NUMBER
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1732

MAIL DATE	DELIVERY MODE
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05/11/2007

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/799,160

Applicant(s)

HA ET AL.

Examiner

Janis Sanders

Art Unit

1732

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 24 January 2007.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1 and 3-44 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1 and 3-44 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____

- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____

DETAILED ACTION

Response to Amendment

Applicant's amendment to claims in the reply filed on 1/24/2007 is acknowledged.

Claims 1,3,4,15 and 23-25 have been amended and claim 2 has been cancelled.

Claims 1,3-44 are currently pending.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1,3-5,7-8,11-12,15-25,27-28,31-32 and 35-44 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zakhidov et al (U.S. Patent 6,261,469).

Zakhidov et al, hereafter "Zakhidov", discloses a method of producing an inverse replica, as recited in claims 1,3-4,23-25 and 43-44. Zakhidov teaches assembling spheres of a first material into an opal-like lattice and connecting the spheres with "necks" (bicontinuous structure) by sintering thereby leaving a percolated void space. Zakhidov further teaches infiltrating this space (second phase) with a second material (third phase) and removing the first material (first phase) to create an inverse replica (immobilized third phase). See lines 33-67 in column 6. Zakhidov still further teaches infiltrating a third material into the interstitial space of the inverse replica and removing

the second material to form a direct replica. See lines 14-21 in column 7. The infiltrating materials are fluids. See lines 18-25 in column 12. It would have been obvious to one of ordinary skill to carry this pattern of infiltration and removal an additional step further to produce a second inverse replica.

Zakhidov teaches that a shrinking step can be accomplished with an infiltrated phenolic material by pyrolysis, as required by claims 1, 4, 20, 23, 40 and 44. See lines 40-67 in column 17. It would have been obvious to one of ordinary skill to use the phenolic material for either the second or third infiltrate thereby creating either a shrunken inverse replica or a shrunken direct replica.

Zakhidov teaches an opal-like matrix comprised of silica-coated polystyrene spheres (first solid phase) which shrink by 20-35% upon removal of the polystyrene by burning (pyrolysis) thereby leaving a shrunken silica template, as required by claim 43. See lines 20-32 in column 2.

Zakhidov teaches that the opal-like template has a face-centered cubic (ordered) arrangement, as required by claim 5. See lines 1-10 in column 11.

Zakhidov teaches that the unit cell contraction upon pyrolysis of the phenolic inverse replica is 20% or higher, as required by claims 7 and 27. See lines 63-76 in column 17.

Zakhidov teaches that a polymer precursor is used for an infiltrate (first or second fluid), as required by claims 8, 15, 28 and 35. See lines 40-45 in column 17. It would have been obvious to one of ordinary skill to use the same infiltrate a second time (i.e., both first and third fluids), as required by claims 16 and 36.

Zakhidov teaches an infiltrate composition as having a diblock polymer involving linkages, among others, of poly(dimethylsiloxane). See lines 59-63 in column 11. It would have been obvious to one of ordinary skill that the precursor to such a material would be dimethyl siloxane, as required by claims 11 and 31.

Zakhidov teaches that the infiltrate is immobilized by polymerization, as required by claims 12 and 32. See lines 40-45 in column 17.

Zakhidov teaches infiltration of polystyrene under vacuum into an opal-like template of SiO₂ spheres displacing air (second phase), as required by claims 17 and 37. See Example 4, lines 59-67 in column 29 and 1-5 in column 30.

Zakhidov teaches that an opal-like template (first phase) comprised of SiO₂ spheres is removed by dissolving in aqueous HF while leaving the infiltrate (third phase) in place, as required by claims 18 and 38. See lines 47-51 in column 17.

Zakhidov teaches removal of SiO₂ spheres (first phase) by KOH etch (chemical etching), as required by claims 19 and 39. See lines 28-38 in column 15.

Zakhidov teaches that an infiltrate composition (third phase) of polydimethylsiloxane, as required by claims 21 and 41. See lines 59-64 in column 11.

Zakhidov teaches that the infiltration of the second material (first fluid) can be done by chemical vapor deposition, as required by claims 22 and 42. See lines 1-5 in column 12.

Claims 6 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zakhidov as applied to claims 1,3-5,7-8,11-12,15-25,27-28,31-32 and 35-44 above, and further in view of Taboas et al (U.S. Patent Application Publication 2003/0006534).

Zakhidov teaches the method of claims 1,3-5,7-8,11-12,15-25,27-28,31-32 and 35-44, as discussed above.

Zakhidov does not teach a bicontinuous structure formed by a molding process, a solid freeform fabrication (SFF) process, or a biological process, as required by claims 6 and 26.

Taboas et al, hereafter "Taboas", teaches fabrication of a "mold", having a porous structure (bicontinuous) wherein an inverse replica is cast, by 3D printing (SFF technique). See paragraph [0058].

Zakhidov and Taboas are combinable because they are concerned with a similar technical field, namely, forming macroporous structures for templating. One of ordinary skill in the art at the time of the invention would have found it obvious to include in the method of Zakhidov the scaffold fabrication technique, as taught by Taboas. The motivation to do so would have been the enhancement of control over pore size and interconnectivity in forming a bicontinuous structure. See paragraph [0015] of Taboas.

Claims 9-10,13-14,29-30 and 33-34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zakhidov in view of Taboas as applied to claims 1,3-8,11-12, 15-28,31-32 and 35-44 above, and further in view of Narang et al (U.S. Patent 5,980,813).

Zakhidov and Taboas teach the method of claims 1,3-8,11-12,15-28,31-32 and 35-44, as discussed above.

Zakhidov and Taboas do not teach composition of the polymer precursor as an organometallic, as required by claims 9 and 29, or a polysilazane, as required by claims 10 and 30. Zakhidov and Taboas further do not teach molten metal or semi-metal as an infiltration fluid material, as required by claims 13 and 33, or that immobilization of the metal is accomplished by freezing, as required by claims 14 and 34.

Narang et al, hereafter "Narang", teaches a build material as a metal covalently bound to a polymeric precursor (organometallic). See lines 48-60 in column 3. Narang further teaches a build material as a polymerizable silazane at lines 40-45 in column 6. Narang still further teaches a metal build material applied in a molten state thereafter to solidify by freezing. See lines 1-12 in column 13.

Zakhidov, Taboas and Narang are combinable because they are concerned with a similar technical field, namely, SFF-directed structures. One of ordinary skill in the art at the time of the invention would have found it obvious to include in the method of Zakhidov and Taboas the unique materials of Narang. The motivation to do so would have been to expand the field of application by providing electrical, thermal, and magnetic conducting paths within a bicontinuous structure. See lines 47-57 in column 2 of Narang.

Response to Arguments

Applicant's arguments filed 24 January 2007 have been fully considered but they are not persuasive.

Applicant's arguments appear to be on the following grounds:

1. The applicant first argues that Zakhidov does not teach a method to produce a shrunken direct replica. More specifically, Zakhidov teaches away from any further processing of a shrunken replica or a shrunken inverse replica to make further replicas, as is now required by Applicants' claims. The applicant further argues accordingly, that each and every element of the claims as amended is not disclosed in Zakhidov.
2. The applicant argues one of ordinary skill in the art would not have been motivated to adapt or modify the teachings of Zakhidov to produce a shrunken replica. Zakhidov specifically teaches that methods resulting in shrinkage are unsatisfactory and produce an imperfect structure: (Column 2, lines 19-45). As Zakhidov specifically states that shrunken replicas, as opposed to exact replicas, are unsatisfactory and imperfect, one having ordinary skill in the art would have been completely unmotivated to use the shrunken inverse replica of Zakhidov to produce a further shrunken direct replica.
3. The applicant argues Taboas does not provide the necessary teachings sufficient for one skilled in the art to combine with Zakhidov and then to modify the combined teachings to somehow derive the presently claimed methods. Taboas fails to remotely suggest methods for making any type of shrunken inverse replica or shrunken replica.

Art Unit: 1732

One of ordinary skill in the art would have had no reason to combine Taboas and Zakhidov, as the references mention structures for addressing unrelated problems in non-analogous arts.

4. Finally, the applicant argues Narang does not provide the necessary teachings sufficient for one skilled in the art to combine with Zakhidov and then to modify the combined teachings to somehow derive the presently claimed methods. Narang fails to remotely suggest methods for making any type of shrunken inverse replica or shrunken replica. One of ordinary skill in the art would have had no reason to combine Taboas and Zakhidov, as the references mention structures for addressing unrelated problems in non-analogous arts.

These arguments are not persuasive for the following reasons:

1. It is the position of the examiner that the reference Zakhidov et al (U.S. Patent 6,261,469) does teach a production of a direct shrunken replica. Zakhidov teaches at a fourth step, the initial opal material is dissolved or otherwise removed to obtain a hollow structure that is an inverse replica of the original opal structure (col. 6, lines 58-65). This inverse replica is either called a volumetrically-templated inverse opal (FIG. 3), if the step three infiltration of B was volumetric templating, or a surface-templated inverse opal (FIG. 9), if the step three infiltration of B was surface templating. This inverse opal replica is further transformed by additional processing. For example, the volumetrically-

Art Unit: 1732

templated inverse opal is used as a template for the periodic deposition of a material C within the interstitial space left by the removal of the original spheres of material A. In another optional step, the material B can be removed, so as to result in a direct opal lattice comprising only material C (column 7, lines 14-21). The reference clearly states an inverse replica is produced. A 'material B' can be removed to result in a direct opal (replica). The examiner submits that teachings include all elements of the amended claims including further optional steps (phases) as disclosed by Zakhidov (col. 7, lines 21-42). The examiner evaluates the term 'template' as a mold used to establish or serve as a pattern. As previously examined, it would have been obvious to one of ordinary skill to carry this pattern of infiltration and removal an addition step further to produce a second inverse replica.

2. In response to applicant's argument that the examiner's conclusion of obviousness is based upon improper hindsight reasoning, it must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the applicant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971). In this case, it is the position of the examiner that the reference Zakhidov et al (U.S. Patent 6,261,469) does not teach that methods resulting in shrinkage are unsatisfactory and produce an imperfect structure. The Applicant refers to passage

Art Unit: 1732

provided within: col.2, lines 19-45; which is from cited reference: B.T. Holland et al., Science 281, 538 (1998), and not from the disclosed invention of Zakhidov. Zakhidov does teach of a fabrication of an inverse three-dimensional structure, which reflects a 20% or higher contraction in unit cell dimension (col. 17, lines 40-67).

3. In response to applicant's argument that there is no suggestion to combine the references, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992).

In this case, it is the position of the examiner that the reference Zakhidov et al (U.S. Patent 6,261,469) teaches methods for making a shrunken inverse replica or shrunken replica of a three-dimensional structure. However, the reference does not teach of a bicontinuous structure formed by a molding process, a solid freeform fabrication (SFF) process, or a biological process. Taboas teaches fabrication of a "mold", having a porous structure (bicontinuous) wherein an inverse replica is cast, by 3D printing (SFF technique) [0058]. Zakhidov and Taboas are both concerned with forming macroporous structures for templating. Together, the references would motivate the enhancement of control over pore size and interconnectivity in forming a bicontinuous structure

(Taboas:[0015]). Therefore, it is the position of the examiner that one of ordinary skill would have a reasonable expectation of success from the combination.

4. In response to applicant's argument that there is no suggestion to combine the references, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, it is the position of the examiner that Zakhidov does teach of a production of a direct shrunken replica. Zakhidov does not teach composition of the polymer precursor as an organometallic, or a polysilazane. Zakhidov further does not teach molten metal or semi-metal as an infiltration fluid material, or that immobilization of the metal is accomplished by freezing. Narang teaches a build material as a metal covalently bound to a polymeric precursor (organometallic) (col.3, lines 48-60). Narang further teaches a build material as a polymerizable silazane (col.6, lines 40-45). Narang still further teaches a metal build material applied in a molten state thereafter to solidify by freezing (col.13, lines 1-12). Zakhidov and Narang are combinable because they are concerned with SFF-directed structures. Together, the references would motivate to expand the field of application by providing electrical, thermal, and magnetic conducting paths within a bicontinuous structure (Narang: col.2, lines 47-57). Therefore, it is the position of the examiner that

one of ordinary skill would have a reasonable expectation of success from the combination.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.


Any inquiry concerning this communication or earlier communications from the examiner should be directed to Janis Sanders whose telephone number is 571-272-7145. The examiner can normally be reached on M-F 8-5pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Christina Johnson can be reached on 571-272-1176. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Art Unit: 1732

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

4/27/07


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SUPERVISORY PATENT EXAMINER
5/3/07